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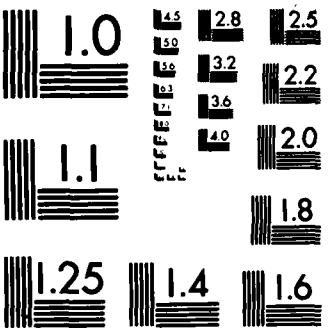

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Final Technical Report to

U. S. Army Research Office
Electronics Division
P. O. Box 12211
Research Triangle Park, NC 27790

Attention: Dr. James W. Mink

for

FINITE-ELEMENT APPROACH TO GUIDED WAVE PROBLEMS

(Contract DAAG29-80-K-0051)

PRINCIPAL INVESTIGATOR:

Cavour Yeh
Professor

Electrical Engineering Department

March 1983

Submitted by

THE REGENTS OF THE UNIVERSITY OF CALIFORNIA
UNIVERSITY OF CALIFORNIA, LOS ANGELES
SCHOOL OF ENGINEERING AND APPLIED SCIENCE
405 Hilgard Avenue
Los Angeles, California 90024

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Abstract

This report summarizes the results of the research carried out at the Electrical Engineering Department of the University of California at Los Angeles under contract DAAG29-80-K-0051 with the Army Research Office. The research dealt with the analyses of guided wave problems for millimeter/optical dielectric waveguide structures as well as acoustic wave guiding structures using the finite-element technique.

I. Introduction

This is a final report on a study sponsored by the Army Research Office (DAAG29-80-K-0051) and conducted in the Electrical Engineering Department of the University of California, Los Angeles. This research effort is concerned with the theoretical investigations on the wave-guiding characteristics of dielectric structures with special emphasis on applications in fiber optics, millimeter wave integrated circuits and integrated optics.

Three problem areas have been treated resulting in the publication of three technical papers/reports and two conference presentations.

II. Summary of Our Accomplishments

A. Applications of Finite Element Method to Integrated Optical or Millimeter Wave Dielectric Waveguide Circuits

It has become increasingly clear that at higher microwave frequencies such as millimeter or submillimeter range or at optical frequencies, dielectric structures are the appropriate wave guiding structures. The basic configuration consists of a higher index wave guiding region surrounded by a lower index region(s). Due to the complexity of the structures, exact analysis can only be carried out for a few simple geometries such as circular/elliptical cylinders or slabs. The finite-element technique is developed to remedy this situation. Using this very powerful and unique approach we are able to obtain accurate results for a variety of practical waveguiding structures such as, inhomogeneous circular or rectangular dielectric guides, the circular or rectangular dielectric waveguide couplers, mm wave microstrip integrated circuit guides and couplers, isolated image guide for mm wave circuits, and the strip and inverted strip dielectric guides and couplers, to name

a few. Results of our research have been summarized in a technical report entitled, "Applications of Finite Element Method to Integrated Optical or Millimeter Wave Dielectric Waveguide Circuits," by C. Yeh, T. Mazidu and S. Dong, UCLA-ENG-EE101, January, 1982. We are also in the process of condensing this material and preparing for publication as a technical paper.

B. Dynamic Analysis of Microstrip on Anisotropic Substrate

For dielectric medium which is anisotropic, it would be more convenient to use the transmission line matrix technique to treat the problem. We have successfully adapted this technique to solve the problem of mm or submm wave propagation along a stripline structure with anisotropic (Sapphire) substrate. Dynamic dispersion characteristics for the dominant mode were obtained. Results of our research have been given in a technical paper entitled, "Dymanic Analysis of Microstrip on Anisotropic Substrate," by G. E. Mariki and C. Yeh, which has been submitted for publication in IEEE Trans. on MTT.

C. Microwave Acoustic Waveguide

We have also analyzed a triangular ridge type microwave acoustic waveguide and coupler using the finite-element method. The triangular ridge guide was studied because of the excellent compromise it offers between strong guidance and low dispersion. Results of our research have been published in a paper entitled, "Triangular Ridge Acoustic Waveguide and Coupler," by W. A. Oliver, S. B. Dong and C. Yeh, J. Acous. Soc. Am. 69, 145 (1981).

III. Personnel

Principal Investigator: Prof. Cavour Yeh

Geoffrey Mariki (Graduate Student)

Farzim Manshadi (Graduate Student)

Tiberin Mazilu (Graduate Student)

W. A. Oliver (Graduate Student)

Richard Yeh (Programmer)

Osman Kaldinim (Graduate Student)

Prof. S. Dong (Research Associate)

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

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